

# CARBON DIOXIDE REACTION PROCESSES IN A MODEL BRINE AQUIFER AT 200 C AND 200 BARS: IMPLICATIONS FOR SUBSURFACE CARBON SEQUESTRATION

KASZUBA, John P., Environmental Science and Waste Technology, Los Alamos National Lab, Mail Stop J514, Los Alamos, NM 87545, jkaszuba@lanl.gov, JANECKY, David R., Environmental Science and Waste Technology, Los Alamos National Lab, Mail Stop J591, Los Alamos, NM 87545, and SNOW, Marjorie G., Earth and Environmental Sciences, Los Alamos National Lab, Mail Stop D469, Los Alamos, NM 87545,

Injection of carbon dioxide into saline aquifer systems is being evaluated as a basis for in-situ geologic storage and/or sequestration. While the technical aspects of collection, injection and formation of a relatively stable carbon dioxide fluid in the rock pore space are essential to storage, the stability of the containment interface is also critical to long-term sequestration. However, the reactive behavior of carbon dioxide under reservoir conditions is largely unknown. Key reaction conditions and components include temperature, pressure, brine and liquid composition, and minerals.

We are continuing to experimentally model the chemical components and reactive behavior of a reservoir-aquitard system. Our experiments employ a flexible cell hydrothermal apparatus consisting of a gold reaction cell within a rocking autoclave. The aquifer is a synthetic arkose (potassium feldspar+oligoclase+quartz+biotite), the aquitard is argillaceous shale, and the brine has an ionic strength of 5.5 molal. After reaction to steady state between brine and minerals at 200 C and 200 bars, carbon dioxide was injected into the system and the experiment continued for 80 days. Ca, Mg, Br, and SO<sub>4</sub> decreased in the steady state CO<sub>2</sub>-brine-arkose-shale system relative to the CO<sub>2</sub>-free system, whereas K increased. A pressure decrease of 26 bars occurred in the experimental cell over a 3-day period following carbon dioxide injection. Pressure was stable afterwards. The pressure decrease is interpreted as consumption of supercritical carbon dioxide fluid by dissolution in brine and subsequent precipitation as carbonate mineral. SEM and XRD examination of the solids showed euhedral magnesite as a reaction product. Two distinctive morphologies of magnesite were present. SEM analysis also indicates the shale was being consumed by reaction. The experimental reactions provide initial constraints on mineral reactions that may impact the containment interface in moderate temperature brine aquifer systems with potential for carbon sequestration.

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